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Editorial Team: Pawan Rai and Sabita Badal

For the 711th - 712th issues of Headlines Himalaya, we reviewed researches from four sources and selected 11 researches from four countries. We selected four researches from Nepal and seven researches from other Himalayan Countries (India, China and Pakistan).

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VEGETATION LOSS AND RECOVERY ANALYSIS FROM THE 2015 GORKHA EARTHQUAKE (7.8 MW) TRIGGERED LANDSLIDES

Hari Prasad Pandey, Kaushal Gnyawali, Kshitij Dahal, Narayan Prasad Pokhrel, and Tek Narayan Maraseni

Land Use Policy 119: 106185

The 2015 Gorkha earthquake (7.8 Mw) triggered thousands of landslides in the highlands of central Nepal, causing widespread vegetation damage. After the earthquake, several attempts were made by the government to recover damaged vegetation; however, the efficacy of artificial restoration (from public finance) vs. self-ecological restoration is unknown. We analyze the vegetation recovery process of the areas impacted by the 2015 Gorkha earthquake landslides with a dual-lens: (1) remote sensing and (2) public finance and policy. Using remote sensing, Vegetation Recovery Rate (VRR) is estimated from the normalized difference vegetation index (NDVI) from Landsat imagery between 2015 and 2021. Then public finance data is analyzed to compare the efficacy of vegetation recovery from the artificial vs. self-ecological restoration. The study examines fourteen severely impacted districts from the Gorkha earthquake in 2015. Out of 24,826 landslides triggered by the earthquake, ~95% of vegetation damage was caused by 13,670 large landslides (with area >0.09 ha). A total of 8651.58 ha of vegetation was lost due to landslides induced by the 2015 Gorkha earthquake. About 4442 ha (51%) of such lost vegetation has been restored so far. Only 9.5% of this restored vegetation was due to artificial restoration, while the remaining 90.5% was by self-ecological restoration process in protected areas. Furthermore, VRR analysis showed that at least nine years are required to restore vegetation cover to the pre-earthquake level ($R^2 = 0.91$). The government had invested 3.73 million USD in this duration for artificial restoration. Our findings suggest that strict protection promotes self-ecological restoration, an effective tract for vegetation recovery, over artificial interventions. Findings provide insights for plausible decision-making in restoring lost vegetation due to earthquake-triggered landslides.

For Further Reading: <https://doi.org/10.1016/j.landusepol.2022.106185>

DROUGHT INDEX PREDICTABILITY FOR HISTORICAL AND FUTURE PERIODS ACROSS THE SOUTHERN PLAIN OF NEPAL HIMALAYA

Suraj Shah, Achyut Tiwari, Xianfeng Song, Rocky Talchabahdel, Teleshore Habiyakare, and Arjun Adhikari

Environmental Monitoring and Assessment 194: 642

Drought episodes across the Himalayas are inevitable due to rapidly increasing atmospheric temperatures and uncertainties in rainfall patterns. Tarai of Nepal is a tropical region located in the foothills of the Central Himalaya as a country's food granary with a contribution of over 50% to the entire country's agricultural production. However, there is a lack of detailed studies exploring the spatiotemporal occurrence of drought in these regions under the changing climate. In this study, we used the ensemble of nine climate models from the Coupled Model Intercomparison Project Phase 6 (CMIP6) under two shared socio-economic pathways (SSPs), namely SSP245 (an intermediate development pathway) and SSP585 (a high development pathway), to assess anticipated drought during the mid-century. We used bias-corrected gridded data from the Worldclim to project drought events by the end of the mid-century based on the historical period (1989–2018). We computed historical and projected

Thornthwaite moisture index (TMI) to evaluate soil moisture conditions on a seasonal scale for the Tarai region's Eastern, Central, and Western parts. The model ensemble projected a significant increase in precipitation and temperature for the entire Tarai by the end of mid-century. However, the winter and spring seasons are projected to suffer precipitation deficiency and a temperature rise. Our results indicated that the Eastern Tarai would likely experience a decrease in winter precipitation. We emphasize that the presented spatiotemporal pattern of the MI will be instrumental in addressing the irrigation facility's needs, choice, and rotation of crops under the changing climate scenarios and in improving our mitigation measures and adaptation plans for sustainability of the agriculture in drought-prone areas.

For Further Reading: <https://doi.org/10.1007/s10661-022-10275-6>

DIFFERENTIAL IMPACT ANALYSIS FOR CLIMATE CHANGE ADAPTATION: A CASE STUDY FROM NEPAL

Chiranjeevee Khadka, Anju Upadhyaya, Magda Edwards-Jonášová, Nabin Dhungana, Sony Baral, and Pavel Cudlin

Sustainability 14: 9825

Following a case study, community adaptation plans are a bottom-up approach that focus on increasing climate-vulnerable communities' engagement in local adaptation planning and policy design, prioritization, and implementation in Nepal. This paper explains how Community-Based Adaptation Action Plan (CAPA) groups are being studied to assess the climate vulnerability of the local socio-ecosystem and to develop community-level adaptation measures. However, there is insufficient research to differentiate local vulnerabilities caused by climate change. This paper, therefore, examines climate change vulnerability with respect to community vulnerability and potential adaptation measures to increase community resilience and adaptive capacity through CAPAs. The study compares differences by gender, caste/ethnicity, and wealth in relation to specific climate-related hazards (exposure, sensitivity, and adaptive capacity) of communities. The study draws on secondary sources of information along with field observations, 73 household interviews, 13 key-informant interviews, consultations, and 9 interactive meetings in 3 districts of Nepal. Differential impact analysis refers to the exposure, sensitivity, and adaptive capacity of local socio-ecological systems. In addition, multivariate analysis was conducted using the Canoco program to analyze the role of actors with respect to climate vulnerability. The results conclude that the degree of vulnerability varies widely at the household level and is strongly influenced by socio-economic characteristics such as gender, caste/ethnicity, and wealth. Immediate and focused attention is needed to improve access to government resources for vulnerable households, requiring positive support from decision makers. Equally important is improving the chain of communication, which includes information, skills, knowledge, capacity, and institutional arrangements. Analysis of the differential vulnerability and the adaptive capacity of a vulnerable community is more appropriate for the design of local adaptation plans. Therefore, the study suggests that engagement of local partners, including local authorities, in addressing vulnerability and adaptation is required to confront the social process, new institutional arrangements, local adaptation, and capacity-building with technical solutions.

For Further Reading: <https://doi.org/10.3390/su14169825>

BEHAVIORAL DETERMINANTS OF MATING SUCCESS IN BLACKBUCK UNDER SEMIENCLOSED CONDITION: A CROSS-SECTIONAL STUDY IN SHUKLAPHANTA NATIONAL PARK, NEPAL

Puja Saud, Juna Neupane, and Mukesh Kumar Chalise

Knowing reproductive behavior is important for establishing a viable population of nationally endangered blackbuck in Nepal. This study explored the behavioral events and states associated with copulatory mountings in blackbuck by focal animal sampling method under semienclosed conditions of Hirapurphanta within Shuklaphanta National Park, Nepal. We recorded different behavioral initiations for the mating reproductive activities and the behaviors followed after copulatory mounting. Four dominant adult males were used as a subject. The highest number of copulatory mountings was observed during the months of February–March. Among the diurnal observational phases, the highest number of copulatory mountings was recorded during 9.00–12.00 hours followed by 15.00 hours onwards. Copulatory mounting was significantly preceded by sniffing the vulva of female and showing flehmen response, whereas copulatory mounting was followed by walking.

For Further Reading: <https://doi.org/10.1155/2022/8713116>

India-Himalaya

SPATIAL AND TEMPORAL PATTERNS OF LARGE MAMMAL HUNTING IN A CHANGING SWIDDEN SYSTEM OF ARUNACHAL PRADESH, INDIA

Anirban Datta-Roy

Human Ecology 50: 1-14

The hunting of wildlife is a contentious issue that conservationists see as the biggest threat to biodiversity. At the same time, forest-dwelling indigenous tribes depend on it for various socioeconomic and cultural needs. Lack of data on hunting offtakes, and spatial and temporal patterns of hunting have hindered a detailed understanding of these activities, especially in swidden landscapes. I documented spatial and temporal patterns of large mammal subsistence hunting among an Adi village of Arunachal Pradesh over 22 months. Results show that secondary forests and swidden fallows within 6 km from the village are critical areas for hunters, contributing 45% of hunted animals and accounting for 56% of total biomass extracted. This 'garden hunting' highlights the importance of swidden landscapes for hunters and anthropogenic fauna like barking deer (*Muntiacus muntjak*) and wild pig (*Sus scrofa*). Maintenance of swidden landscapes that allow garden hunting appears crucial to reducing hunting pressure on nearby undisturbed forests.

For Further Reading: <https://doi.org/10.1007/s10745-022-00327-3>

HOTSPOT AND TREND ANALYSIS OF FOREST FIRES AND ITS RELATION TO CLIMATIC FACTORS IN THE WESTERN HIMALAYAS

Sunil Kumar and Amit Kumar

Natural Hazards 113: 1-14

Forest fire is one of the main issues of forest ecosystems around the world which has resulted in loss of biodiversity, forest degradation, soil erosion, and greenhouse gas emission. Ironically, the information on the forest fire regime and its pattern are still lacking in the Himalayan region. In this study, Moderate-Resolution

Imaging Spectroradiometer active fire data products from 2001 to 2020 have been analysed for understanding the forest fire trends and its hotspots patterns during the active fire season (February to June). About 1347 average fire counts/year were recorded in six natural vegetations with the highest number of fires observed during the year 2012 ($n = 3096$) and minimum in 2011 ($n = 210$). Mann–Kendall trends analysis for the spatial and temporal pattern of fires indicated that there is a significant increase of forest fires towards higher elevation. Forest fire hotspot analysis using fire radiative power, fire frequency, and fire density showed that Uttarakhand is the most forest fire-prone state as compared to other north-western Himalayan states. It is also revealed that the May month has a higher number of fire counts and the evergreen needle forests have higher fire frequencies amongst the forest types. The forest fires were found to be more influenced by land surface temperature as compared to rainfall. The outcomes in this study on the temporal and spatial patterns for forest fire can be used for forest fire modelling.

For Further Reading: <https://doi.org/10.1007/s11069-022-05530-5>

WATER QUALITY ASSESSMENT USING NSFQI, OIP AND MULTIVARIATE TECHNIQUES OF GANGA RIVER SYSTEM, UTTARAKHAND, INDIA

Gagan Matta, Anjali Nayak, Avinash Kumar, and Pawan Kumar

Applied Water Science 10: 206

Ganga River water is very much stressed with the rapidly increasing population, climate change and water pollution that increase domestic, agricultural and industrial needs. This study assesses the surface water quality of the River Ganga in India, using NSFQI, OIP and multivariate techniques. During the current study, water samples from Ganga River were collected for the assessment of 19 physico-chemical determinants from 20 sampling locations. Water quality indices (WQIs) is used to classify the overall impact of different variables of water. Multivariate techniques were utilized to assess the water conditions for productive management of fresh water quality. The WQI results showed that surface water quality varied at the selected sampling sites among medium and good categories. The PCA generates the 6 principle components which highly contributes (80.3%) in influencing the hydro-chemistry of river water. Agricultural waste runoff, untreated effluents and many other anthropogenic activities were identified as main contributor in decreasing the water quality of the River Ganga. To maintain and protect this fresh water resources against contamination, the usage of stringent policies and rules are expected to preserve fresh water resources for people in the future.

For Further Reading: <https://doi.org/10.1007/s13201-020-01288-y>

ASSESSING THE URBAN SUSTAINABILITY OF THE SLUM SETTLEMENTS IN THE HILL RESORTS OF INDIA: A CASE STUDY OF DARJEELING TOWN

Bishal Chhetri

GeoJournal 87: 1-22

The urban population of India is expected to reach 416 million by 2050. As more and more people shift from rural to urban areas, the urban centers will be facing serious sustainability challenges to meet the requirements of ever increasing population. One of the key problem areas will be the shortages of the affordable housings for the urban poor and the growth of slums. However, these slums are important component of urban ecosystem as they not only provide affordable shelters to the urban poor but also supply the urban area with its cheap labour force,

therefore slums and slum dwellers should be treated as an integral part of urban ecosystem and should be included in the policy frameworks to make urban areas more inclusive and sustainable. This paper examines the sustainability of urban development through livelihood indicators of the slum dwellers of Darjeeling town. This empirical study was carried out in 8 different slum pockets of the town. The data was collected through questionnaires and were subsequently analyzed. The results shows that the slum pockets of Darjeeling town have higher literacy rates (including female literacy rate) as compared to both the national and the state averages, yet its performance in other livelihood indicators is very dismal. The attainment of the lower educational levels by slum dwellers indicates prevalence of very high dropout rates within the community. The slum dwellers face serious levels of deprivation as related to wellbeing indicator and environmental hygiene indicator in regard to access of safe drinking water and sanitation facilities respectively. The slum dwellers of Darjeeling town are forced to live in overcrowded substandard housing conditions with almost no municipal services and are situated on steep slopes which are often prone to the natural disasters. The mixed performance of the slum pockets in regard to the livelihood indicators suggests that the town of Darjeeling has been experiencing unbalanced growth in terms of sustainable development. Therefore a more holistic approach in policy framing is needed to address such multi-faceted problems.

For Further Reading: <https://doi.org/10.1007/s10708-022-10728-y>

USE OF GEOGRAPHICAL INFORMATION SYSTEMS (GIS) IN ASSESSING ECOLOGICAL PROFILE, FISH COMMUNITY STRUCTURE AND PRODUCTION OF A LARGE RESERVOIR OF HIMACHAL PRADESH

H. Chakraborty, T. Kayal, L. Lianthuamluaia, U. K. Sarkar, A. K. Das, S. Chakraborty, B. K. Sahoo, K. Mondal, S. Mandal, and B. K. Das

Environmental Monitoring and Assessment 194: 643

The present study demonstrates the spatial analysis and mapping of fish and different measures of environmental parameters and fish diversity of Pong reservoir, Himachal Pradesh, using Kriging spatial interpolation methods for geographical information system mapping. Seasonal data on environmental parameters, potential fish habitat and fish diversity was collected from lentic (dam), lentic (reservoir), transitional and lotic zone of the reservoir.. Important environmental parameters like water temperature, dissolved oxygen, electrical conductivity, water depth and transparency showed variations across the different zones of the reservoir. The sediment of the reservoir was sandy clay loam in nature as per texture analysis. Fish species richness, Shannon index and evenness index showed a similarity of the lotic and lentic (reservoir) zones of the reservoir. Six potential fish breeding grounds were identified in the reservoir indicating high conservation significance. The analysis of data showed a declining trend in fish production from 456.9 tonnes during the decade 1976–1987 to 347.91 tonnes during 2009–2020. The factors like anthropogenic climate change, predation of a stocked fish juvenile by water birds, undersized fish stocking and unscientific management are the probable reasons for the decreasing fish production. The spatial variation pattern of the water spread area, environmental parameters, fish catch and potential fish breeding grounds depicted in the GIS platform can be used as an important information base by the policy makers for fisheries management. The stocking of large size fish as a stocking material and adequate protection of the potential fish breeding grounds are the key advisories for the sustainable enhancement of fisheries as well as conservation.

For Further Reading: <https://doi.org/10.1007/s10661-022-10292-5>

China-Himalaya

PREDICTION OF NEAR-SURFACE AIR TEMPERATURE IN GLACIER REGIONS USING ERA5 DATA AND THE RANDOM FOREST REGRESSION METHOD

Yifei He, Chao Chen, Bin Li, and Zili Zhang

Remote Sensing Applications: Society and Environment 28: 100824

Near-surface air temperature is an essential physical parameter for estimating the glacier ablation model that is significant to understanding the dynamics of the changes and constant monitoring of glaciers. There is a significant difference between the temperatures in glacier and non-glacier areas at the same altitude, and the estimation model that uses low-altitude automatic weather station (AWS) data cannot be applied to glaciers far away from the stations. In this study, a scheme for air temperature prediction using the random forest regression (RFR) model and the European Centre for Medium-Range Weather Forecasts (ECMWF) Reanalysis 5 (ERA5) data was analyzed. The results show that the average mean absolute error (MAE) and root mean square error (RMSE) of the ERA5 raw temperature product for three glaciers were 4.32 °C and 5.72 °C, respectively. After the RFR model revision, the MAE and RMSE significantly decreased to 1.01 °C and 1.41 °C, respectively. In addition, when the Linzhi weather station was used to calculate the temperature in the Parlung No. 4 Glacier area, the MAE of the Greuell and Böhm (GB) model decreased by 0.18 °C compared to that obtained using the lapse rate method. With our method, long time series of glacier surface air temperature data with high accuracy can be obtained by using short term in-situ temperature measurements.

For Further Reading: <https://doi.org/10.1016/j.rsase.2022.100824>

Pakistan- Himalaya

ASSESSMENT AND IMPACTS OF AIR POLLUTION FROM BRICK KILNS ON PUBLIC HEALTH IN NORTHERN PAKISTAN

Muhammad Subhanullah, Siddique Ullah, Muhammad Faisal Javed, Rafi Ullah, Tahir Ali Akbar, Waheed Ullah, Shams Ali Baig, Mubashir Aziz, Abdullah Mohamed, and Raja Umer Sajjad

Atmosphere 13: 1231

Brick kilns add enormous quantities of organic pollutants to the air that can cause serious health issues, especially in developing countries; poor air quality is associated with community health problems, yet receives no attention in Northern Pakistan. The present study, therefore, assessed the chemical composition and investigated the impacts of air pollution from brick kilns on public health. A field-based investigation of air pollutants, i.e., PM₁, PM_{2.5} and PM₁₀, CO₂, CO, NO, NO₂, H₂S, and NH₃ using mobile scientific instruments was conducted in selected study area locations. Social surveys were conducted to investigate the impacts of air pollution on community health. The results reveal the highest concentrations of PM₁, PM_{2.5}, and PM₁₀, i.e., 3377, 2305, and 3567.67 µg/m³, respectively, in specific locations. Particulate matter concentrations in sampling points exceeded the permissible limits of the Pakistan National Environmental Quality Standard and, therefore, may risk the local population's health. The highest mean value of CO₂ was 529 mg/L, and other parameters, such as CO, NO, NO₂, H₂S, and NH₃ were within the normal range. The social survey's findings reveal that particulate matter was directly associated

with respiratory diseases such as asthma, which was reported in all age groups selected for sampling. The study concluded by implementing air pollution reduction measures in brick kiln industries to protect the environment and community health. In addition, the region's environmental protection agency needs to play an active role in proper checking and integrated management to improve air quality and protect the community from air hazards.

For Further Reading: <https://doi.org/10.3390/atmos13081231>